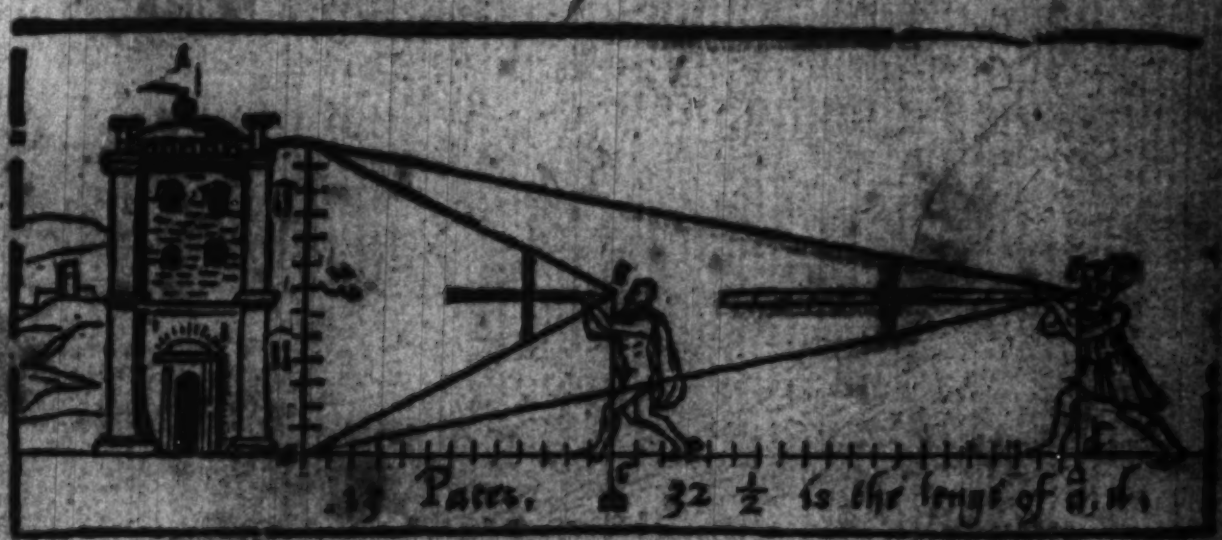
A BOOKE NAMED
Tectonicon,

Briefly shewing the exact measuring, and spedie *reckoning all maner of Land, Squares, Timber, Stone, Steeples, Pillers, Globes,* &c. Further, declaring the perfect making and large vse of the Carpenters Ruler, conteining *a quadrant Geometricall: comprehending also the rare vse of* the Squire. And in the end a little Treatise adioyning, opening the composition and appliancie of an Instrument called the profitable Staffe. With other things pleasant and necessarie, most conducible for Surueyers, Landmeaters, Ioyners, Carpenters, and Masons.

Published By Leonard Digges *Gentleman, in the yeare of our Lord, 1556.*



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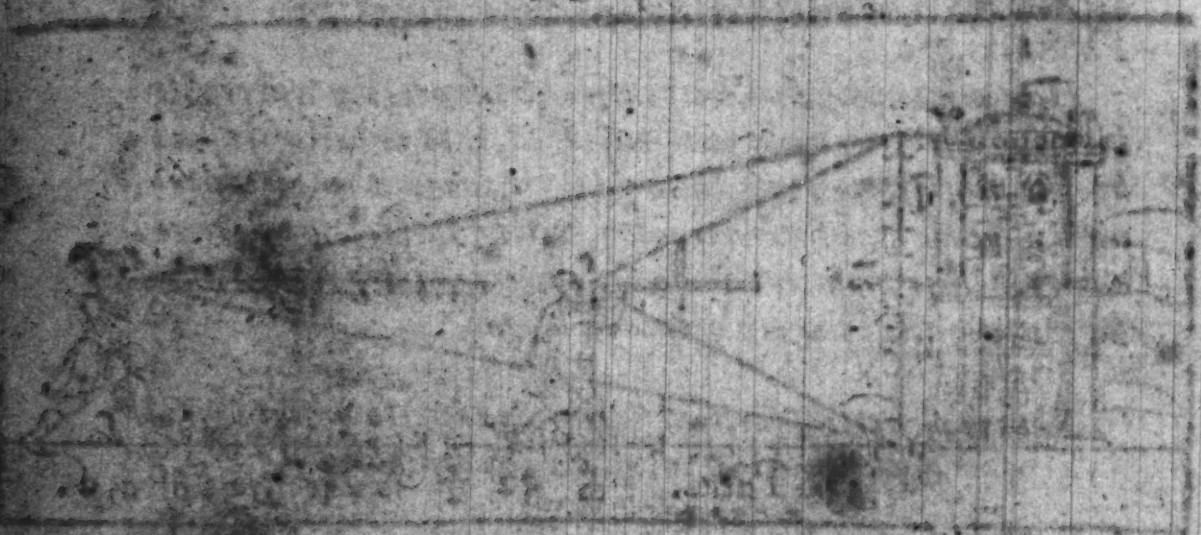


L.D. To the Reader.

Although (gentle Reader) many excellent in Geometrie, vppon infallible grounds haue put foorth diuers most certaine and sufficient Rules, touching the measuring of all maner Superficies: yet in that the Arte of Numbring hath but required, yea chiefly those Rules hid, & as it were locked vp in straunge Tongues, they doe profite (or rather further) very little the most part: Certes nothing at all, the Landmeater, Carpenter, Maſon, wanting the aforesayd. For their sakes, I am here prouoked not to hide, but to open, and so encrease the Talent which I haue receiued: yea to publiſh in this our tongue very shortly (if God giue life) a volume containing the flowers of the Sciences Mathematicall, largely applied to our outward practise, profitably pleasaunt to all maner wights of this Realme. In the meane time I shall desire the Artificers aboue named to be contented with this little Booke (a taſt of my good will towards them) which I wish euen so to further the Readers, as I know is sufficient for the true measuring and readie ouersight of all maner Land, Timber, Stone, Board, Glaſſe, Pauement, &c.

Here mine aduise shall be to these Artificers that will profite in this, or any of my bookes, now publiſhed, or that hereafter shall be, first confuſedly to reade them through, then with more iudgement. Reade at the third reading, wittely to practiſe: So few things shall be vnknowne. Note, oft diligent reading, ioyned with ingenious practiſe causeth profitable labour.

Thus most hartely farewell (louing Reader) to whom I wish my selfe present, to further thy desire and Practiſe in these.

The pleasant profit or content of this little Booke, and in what it exceedeth all other published.

OTher bookes before put forth in our English tongue, contained only the bare measuring of Land, Timber, and Boord: how agreeable in all places to the rules of Geometrie, let the learned iudge. Here (gentle Reader) thou shalt plainly perceiue through diligent reading, how to measure truly, and very speedily all maner land, timber, stone, steeples, pillers, globes, boord, glasse, pauement, &c. without any trouble: not pained with many rules, or obscure termes, nor yet with the multitude of Tables, as heretofore hath beene vsed: in which not a few errours were committed: for that cause no iust account might any way be had. Further, ye shall by this booke vnderstand the whole making and orderly handling of the Carpenters Ruler, with the true measure, &c. And his vse appointed to the ready measuring of all kind of timber, stone, boord, &c. Also the leuelling of grounds, & taking of heights, is pleasantly and diuersly practised by the Ruler. Ye haue here not the common, but the rare vse of the Squire, applied to heights, lengthes, &c. And to the finding of the iust houre of the day diuerse wayes, through the ayd of pleasant Tables newly adioined to my generall Prognostication: by the which the proportion of things direct or squirewise standing, are by their shadowes knowne.

To conclude, in the end of this Booke is added a Treatise, shewing the making, and vse of an Instrument, by which ye shall get lengths, heights, bredths, widenesses, where or howsoeuer they stand. Other necessarie things are contained in this little volume, which I commit to the diligent Reader.

DIVERS THINGS conducible, to the Arte of Measuring.

The first Chapter.

AS there are fewe Craftsmen which haue all the kindes of Arithmatike readily: so I dw suppose none so ignorant, but that they dw, or may easlie perceiue the simple significations of these Caracters or figures 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. And also their strength in the first, second, and third rowmes placed. Character numerall.

Besides that, they must bee familiar with these and such like fractions. Fractions.

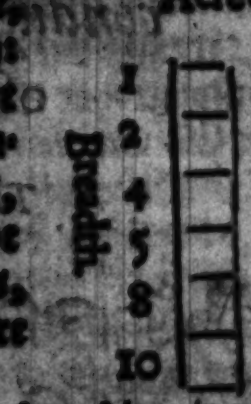
$\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{7}$ $\frac{4}{15}$ $\frac{5}{15}$ $\frac{4}{4}$ $\frac{4}{9}$ $\frac{5}{10}$ The first leftward betokeneth one second part of an whole, be it Pearch, Inch, or any other measure; the next, one third, then one seuenth part: the other ensuing, one sixteenth. So one thirtie and two parts of an Inch. Then followe three fourths: foure fifthes. The last is nine tenthes of an Inch: that is nine parts of an Inch, deuided into ten portions.

These I dw intende to put in my ensamples, and in my Tables and margines following, to represent parts of Pearches or Inches. As if I would write halfe an Inch, after this

this manner ¼. Three quarters of an Inch thus ¾. One eight of a Pearch, on this wise ⅛. So of the reſt.

It is requiſite alſo here to open what a Pearch, a Day worke, a Roode, and an Acre is.

Although there are diuerſe opinions ſuppoſed through long cuſtome in many places, of the length of a Pearch (vpon which our chiefe matter dependeth) yet there is but one true Pearch by Statute appointed to meaſure by, wherein is conteined three Barly cornes dye endwiſe to make an Inch: twelue Inches a Foote: three Foote, a Yarde: fiue Yardes and ½. a Pearch: fourtie Pearches in length, and foure in breadth an Acre. So an Acre by Statute ought to containe 160. Pearches, the halfe Acre 80. Pearches, a Roode comonly called a quarter 40. pearches, a day worke 4. pearches. Lo here ye Acre eppelled with his length, & breadth.



Inſtruments to meaſure with Poales, Cord knoted. Profitable ſtaffe.

I muſt not omit heere to tell you what thing is meeteſt to meaſure land with. They vſe commonly in the country two Poales, either of them the length of a Pearch. They are verie good. Yet for all kinde of Land, a Staffe fiue Pearches in length, well ſeated with waxe and Roſen, knotted or marked at the end of euery pearch, is more meet and readier. But in my fantaſie, the Inſtrument Geometrical, which is put forth in the end of this booke, paſſeth them all and other, for the exact truth and quickeſt ſpeede. This Inſtrument is ſo generall and anapleable to ſo ſundrie things, that it alone requireth a large booke, if it ſhould be ſufficiently ſet forth.

Triangle.

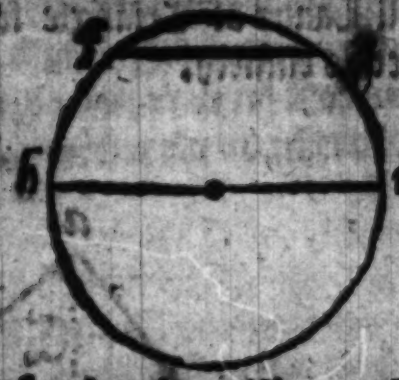
Also I would not haue you ignorant what peece of Land is called a Triangle, which often ſhall hereafter be named. It is ſuch a faſhioned peece as hath (or is imagined to haue) three ſides, and three Angles onely: whether the ſides bee equall or otherwiſe, as this figure ſheweth. Againe, note that a line is ſayd to fall ſquirewiſe, when it cutteth any thing, or any ſide of a Triangle fullcroſſe, like vnto a Squire: As the

Line falling ſquirewiſe.

hanging

hanging pricked line a.b. in c.d. the base line of the triangle. Lo it cutteth the side squirewise, or full crosse in the poynt b. and not as the other line a.c. doth. The base of any Triangle is here called that side, which is cut squirewise of the hanging line.

Concerning a Circle, know that the compasse of any Circle is named a Circumference: the middle poynt in him his Centre, the right line b.i. that goeth ouerthwart that Centre touching the Circumference on both sides is his Diametre: the half of that line, the Semidiametre. Also an Arch is a peece of the Circumference cut away, as ye see the Arch aboue the line f.g. Also f.g.h.i. in this Circle are named Parallels: for that they differ equally in all places, the one from the other.



Note, because practise & experience sheweth me, that there is almost no Land, but it may easily be brought by imagination to a Triangle or Triangles, and so most truly measured: therefore, to be short, this order shall be taken. I will first figure and set afore your eyes Triangled Land, and other which by imagination shal be brought into Triangles. Then I will teach the true measuring of them: I meane, how to finde a length and breadth, with which ye shall enter the table of account following, where the Acres and odde Pearches (if there be any) shall appeare. As these figures are measured, so all triangled land, and other brought into Triangles, of what fashion soeuer they be, shall be measured. And because it is requisite for true measuring of al Triangles, to find a streight hanging line, I shall shew first how that line is to be found, imagined, or drawne.

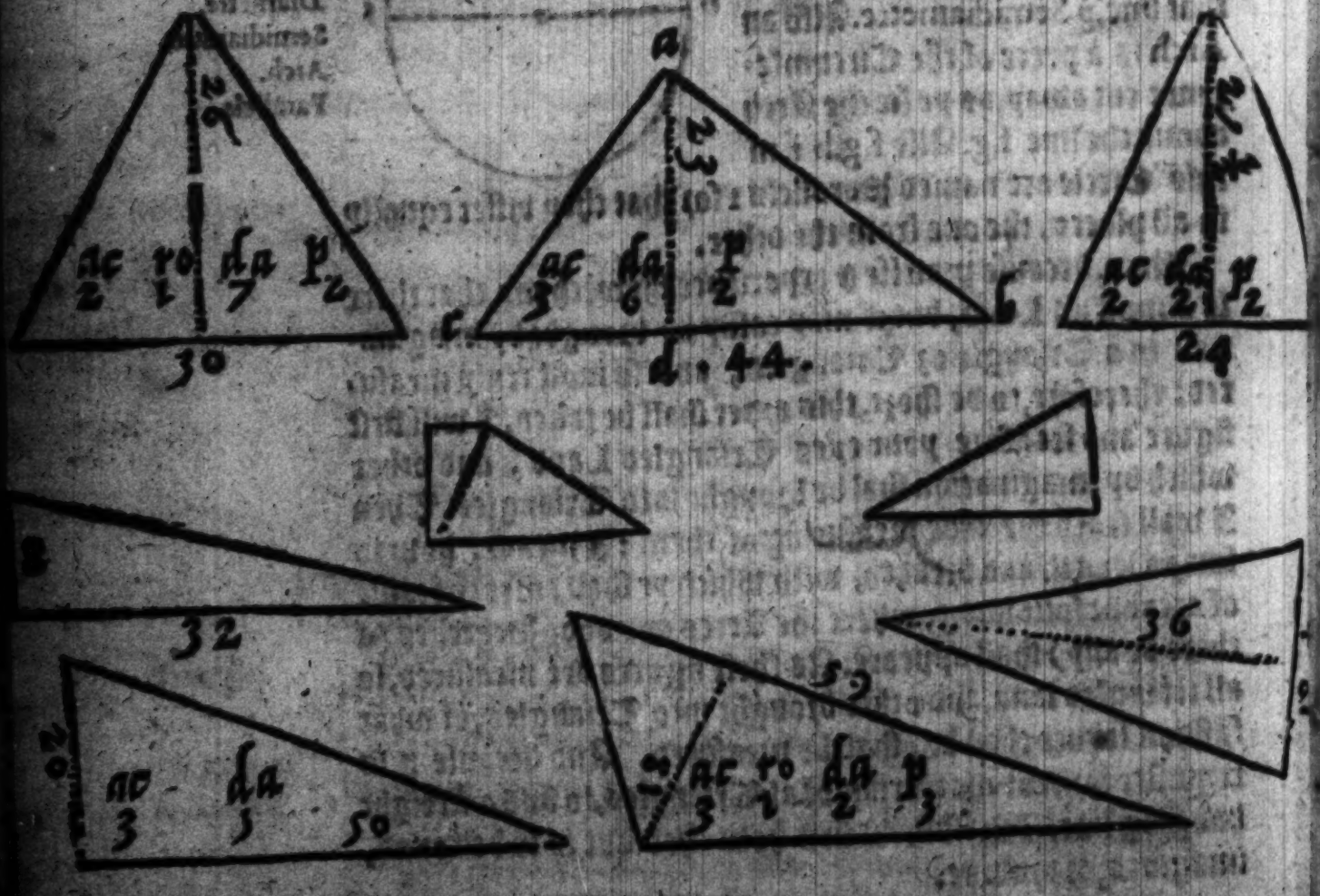
How

How the right hanging line in Triangles is drawne.

The ij Chapter.

To drawé a hanging or plumbe line.

This straight hanging line in all Triangles, is euer drawn or imagined from any Angle, cutting some one sides of that Triangle squirewise: as ye may perceiue the pricked lines in the Triangles following. By the helpe of this line, all Lands of Triangle fashion, are brought to be measured as ensueth.



How

How to meaſure all manner Triangled Land.

The iij. Chapter.

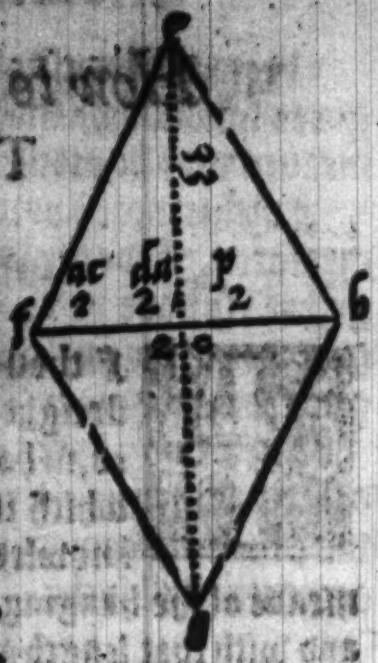
IF thou bee an Arithmetritian, multiplie this ſtreight hanging line, drawne, as aboue is ſhewed, in halfe the number of Pearches of that ſide which it cutteth ſquirewiſe. For want of the knowledge, take the aforenamed Pearches (I meane of the hanging line, and half the ſide which he cutteth) and with that length and breadth enter your table of account, as there is ſet forth. So ſhall ye perceiue the number of Acres, Roods, Dayworkes, &c. Euclide the 1. Booke, 41. pro.

Enſample.

For the perfect meaſuring of Triangles afore figured, and all other, ſuppoſe the ſecond of theſe laſt nine figures of the other ſide, haning written about it a.b.c.d. to be a peece of land whereof I would haue the true meaſure. I finde by a Corde, otherwiſe, the pricked hanging line a d. to be 23. Pearches: the ſide b.c. which it cutteth ſquirewiſe 44. Pearches, whoſe halfe is 22. With theſe 22. and 23. the conuenient length and breadth, I enter the table of accompt. There I finde by that Table at the corner where both the lines of conuenient length and breadth doo meete 3. Acres 6. day workes, and two pearches to be in that Triangle. Thus of all before figured.

Here note your Table muſt euer bee entred with all the Pearches of the hanging line, and with halfe the ſide that hee cutteth ſquirewiſe. Or with the halfe hanging line, and the whole ſide cut. This Table followeth.

A figure of a double Triangle.

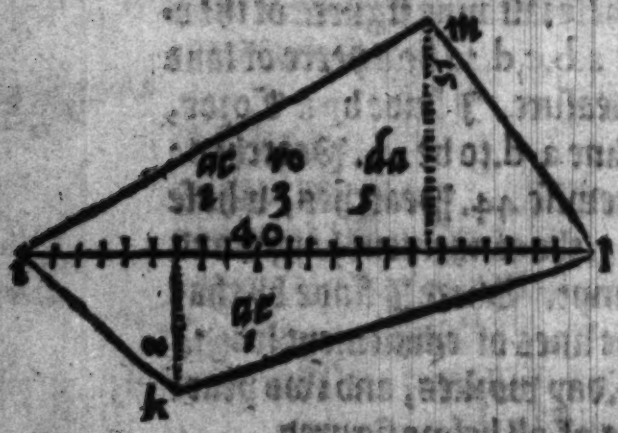


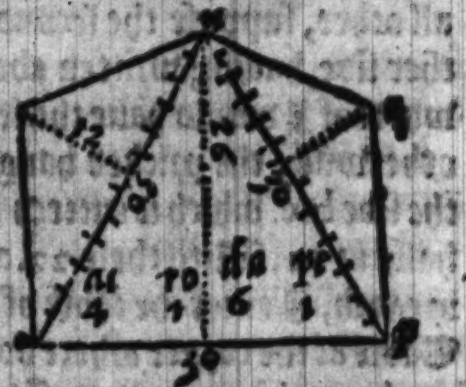
This figure e. f. g. h. is but two Triangles: and therefore measured as aboue in two partes: Or thus. The hanging line e. g. is 33. Pearches: the side f. h. that he cutteth squirewise 20. Pearches, the halfe of the which is 10. Now enter your Table as afore, with 33. and 10. the conuenient length and breadth. So shall ye finde two Acres, two Dayworkes, and two Pearches, the true content of this figure e. f. g h.

Another Ensample.

Figures of many Angles.

ADmit i. k. l. m. land to be measured. Because it is no manner Triangle, it must bee brought by imagination, as I haue sayd, into a Triangle or Triangles. Which imagination is heere signified by the line dashed i. l. Then as aboue is





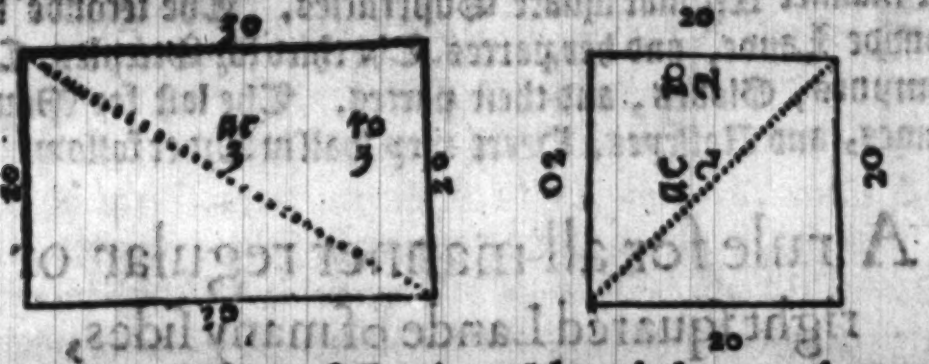
declared, is ought to be measured (according to the rule of Triangles) in two partes, because there are two Triangles in that land. So by prose ye shall finde in the vpper i. m. l. one Acre, 3. Rodes, and fiue Dayworkes: in the other i. k. l. one Acre. Thus I gather the whole content of that land to bee two Acres, three Rodes, and fiue Dayworkes.

None

None otherwise of the ioynes n.o.p.q. and all other figures following: and other whatsoeuer they are, that by any meanes may be brought into Triangles.

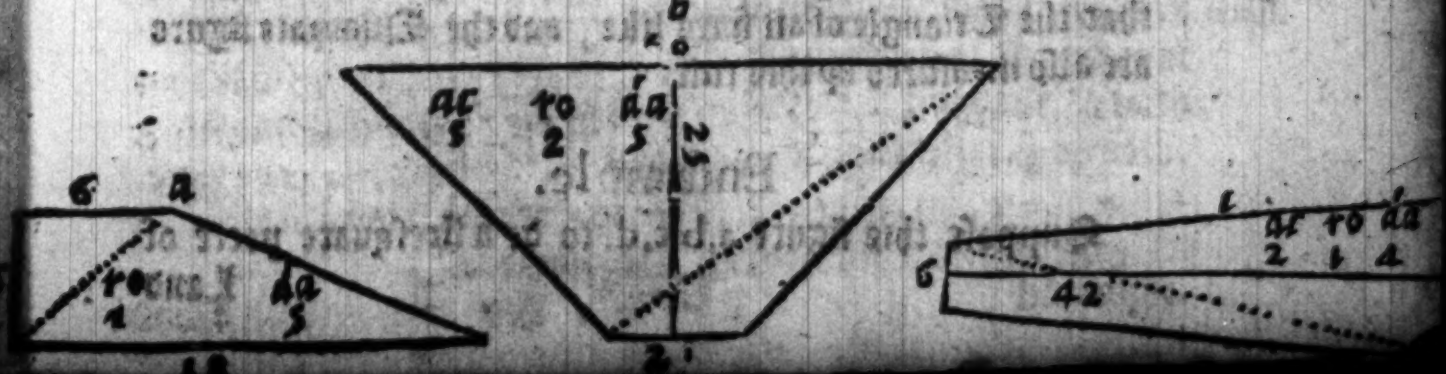
Furthermore know that the figure i.k.l.m. is readily thus measured. Adde the pearches of both the hanging Lines together: so haue ye 23. With this number, and with halfe the pearches of the side i.l. which be cutteth squirewise, being 10 pearches, enter your Table. So is found as afore.

These two figures following may also be thus measured, otherwise then by the rule of Triangles. Enter your Table with their conuenient length and breadth. So shall ye find the contents of all such.



These three figures following, although they may be measured by the rule of Triangles, yet for quicker speed, they haue also their proper measuring as ensueth.

Lay together the two sides which are parallels of the first figure a. that is 6. & 18. making 24. the halfe is 12. the breadth, 5. Enter with 5. and 12. your table. So haue you one rode, and fiue yap workes. For the other two b.c. and such like, ioyne the heads or ends in one: and enter your Table with halfe of those pearches, and with the whole number of the middle line.



How by ſupputation to meaſure *all triangled land.*

To meaſure triangled land by ſupputation

Dyne all the ſides together: take halfe out of that halfe, pull every ſide, noting the difference. Then multiply the differences the one in the other, and the third difference augment in the product. That which encreaſeth, multiplie in the halfe of all the ſides ioyned. Then the Radix of the ſurmounting ſumme is the content of that Triangle.

Foure rules following.

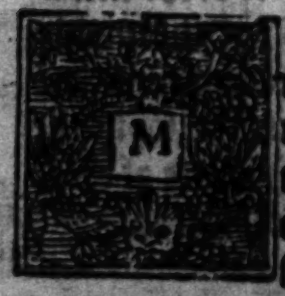
Nowe reſt foure Rules to bee treated of. The firſt for all manner Regular ſquare Superficies. The ſeconde for rounde Lande, and her partes. The third for Steeples, Columpnes, Globes, and their partes. The laſt for Mountaines, and Valleyes. Heere they ſhall in Order follow.

A rule for all manner regular or right ſquared Lande of many ſides,

as 5.6.7.8.9.10.20.100.&c.

The iiii. Chapter.

To meaſure land of many ſides.



Eaſure and lay all the ſides together, taking the halfe number of Pearches there contayned. Then draw a right hanging line from the Centre or middeſt of that figure, or the middeſt of ſome one ſide. And with that length and the other, enter your Table. Note that the Triangle of all ſides like, and the Quadrate figure are alſo meaſured by this rule.

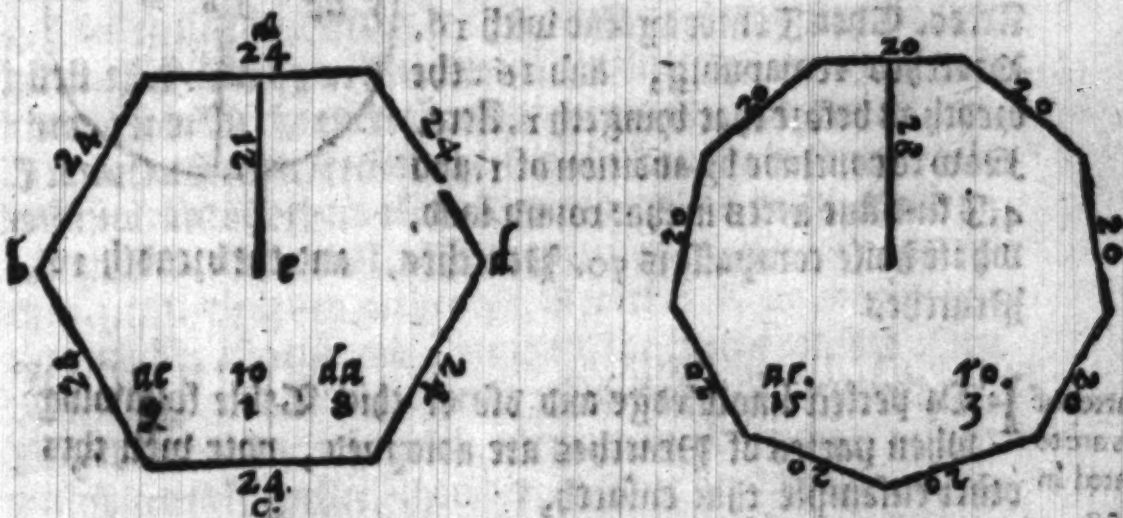
Enſample.

Suppoſe this figure a.b c.d. to be a fyeſquare peece of

Lande

Land, and euery side 24. Pearches. The halfe summe of all sides is 72. Pearches: the right hanging pricked line a.c. 21. Pearches. With these two numbers ye must enter your Table of account following hereafter. And doe as is opened in the declaration there adioyned, when Numbers surmount the Table as they do here.

So shall ye find 9. Acres, 1. Rood, and 8. Daywerkes, the content of this figure a.b.c.d. Euen thus is the other nine squared figures measured, and such like.



A Rule for round land and the partes thereof.

The v. Chapter.

HAlfe the Diametre multiplied in half the Circumference, sheweth the content of any Circle.

Archimedes in libello circuli mensurationis.

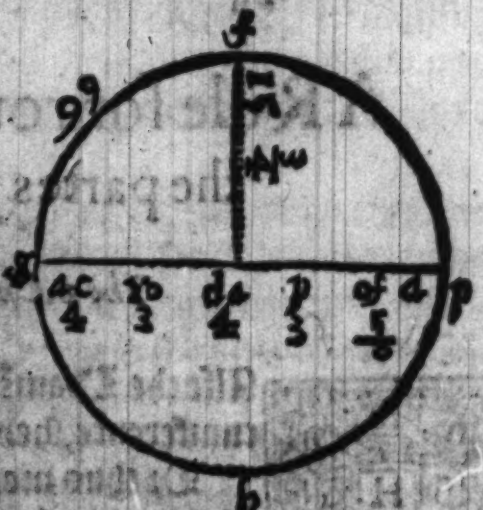
Or thus more plainly. Ye shall enter your Table with halfe the number of Pearches of the whole Circumference or compasse, & with the number of halfe the Diametre or breadth. So haue ye the content.

Ensample.

Supposo a peece of land, whereof the compasse is 100. pearches, the breath 32. Pearches. I would know how much Land is in this figure. Enter your Table with halfe the compasse, that is 50. and with halfe the breadth, that is 16. pearches. Because in the Table I cannot find 50. for the greatest length is 40. (therefore I enter with 40. & 16. So is found foure Acres. Then I enter againe with 10. Pearches remayning, and 16. the breath as before that bringeth 1. Acre. Now to conclude by addition of 1. and 4. I find fiue acres in that round land, whose halfe compasse is 50. Pearches, and the breadth 16. Pearches

How partes of Pearches are to be counted in measuring.

FOr perfect knowledge and vse of this Table following when partes of Pearches are adioyned, note well this other ensample that ensueth, and also what is sayd of the declaration annexed vnto the table, when parts of Pearches are in the length, breadth, or both.



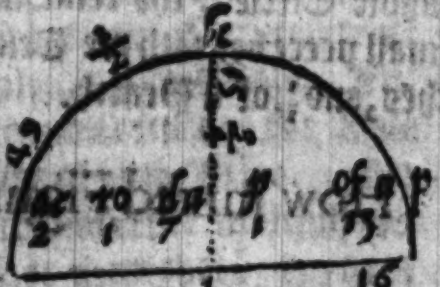
Imagine e.f.g.h. to be a round peece of Land: I find by measure the whole compasse. 99. Pearches. The halfe is 49. 1/2. The hanging Line or halfe breadth is 15. 1/4. Enter your table with the whole Pearches, that is 49. and 15. leauing out 1/2. and 1/4. which were but partes of pearches. So haue ye 4. Acres, 2. Roodes, 3. Dayworkes, and 3. Pearches. For those parts of Pearches omitted, at your first entring the Table,

worke

worke thus. The halfe Pearch, Quarter, or other part of a Pearch in the Length, must be reckoned by themselues in the whole Breadth, and those of the Breadth contrariwise in the Length. If there be such odde parts in both, then reckon them of the Length in the whole Breadth, and them of the Breadth in the whole Length, ioyning to the other afore gotten, remembring the product of the one Fraction multiplyed in the other, to be pulled from the encrease. To make this matter plaine, I will take this last ensample before. The one number wherwith I should haue entred my Table, was 49. ½. the other 15. ¼. I found first by entring with 49. and 15. (omitting the odde partes) 4. Acres, 2. Roodes, 3. Dayworkes, and 3. Pearches. Now for the encrease of the partes of Pearches left out, I must (as I sayd) reckon them of the Length in the breadth, and contrariwise them of the Breadth in the Length. Halfe 15 ¼. is 7. Pearches, and ¾. Three quarters of 49. is 37. Pearches, ½. Which added, makes 45. Pearches. This adioyned to the number afore gotten, bringeth the whole content of the round figure, which is 4. Acres, 3. Roodes, 4. Dayworkes, 3. Pearches, and ⅛. of a Pearch, the product of the one Fraction multiplied in the other subducted. What must be done when the numbers wherewith ye should enter exceede your Table, counsel the declaration of your Table there adioyned.

Of the halfe Circle.

For this halfe circle, enter the Table with halfe this compasse, and with halfe the Diametre of the Circle, or with the length of the pricked hanging Line. k l. So the content of this halfe Circle is 2. Acres, 1. rood, 7. Dayworkes, 1. Pearch, and $\frac{1}{12}$. of a Pearch.



To measure halfe circled Land.

An other ensample of Portions and parts of a Circle.

Suppose n. m. o. following, were a part of a Circle or peece of Land whose Content ye desired. The whole Compasse of the Circle which this portion representeth, is (as aforesayd) 99. Pearches: his Diametre or Breadth 31. $\frac{1}{2}$. The pricked Arke or Compasse. n. m. o. is 74. Now with the halfe Breadth or Semidiametre of the Circle, 15. $\frac{1}{4}$. and with 37. the halfe of the pricked Compasse: enter your Table. So haue ye 3. Acres, 2. Roodes, 5. Dayworkes, 2. Pearches, and $\frac{1}{4}$. of a Pearch, the Content of the peece of Land full of pricks, to the lines of the Triangle pricked.

To measure parts of circled Land.

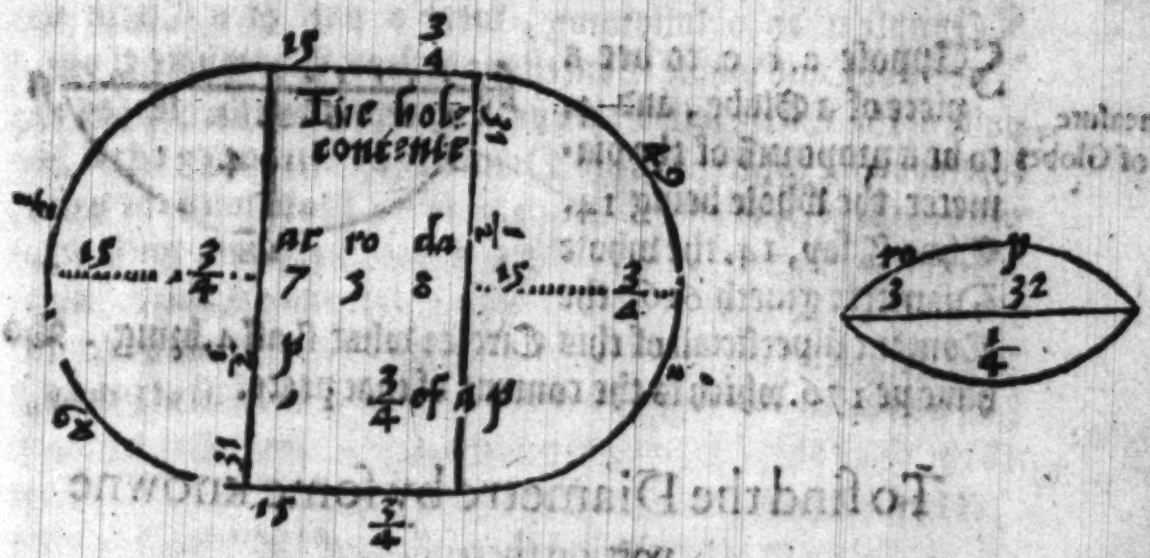
If ye desire to know the sum of Pearches in the other portion beneath the Triangle, separated by the line m. o. yee must adde the content of the Triangle (which is 3. Rodes and $\frac{1}{4}$. of a Pearch, founde by the Rule of Triangles) to the Acres and Pearches before searched. So haue ye 4. acres, 1. Roode, 5. Dayworkes. 3. Pearches, and $\frac{1}{2}$. of a Pearch. This substracted or pulled from the number contayned in the whole Circle, the remaine is the Pearches included in the small peece beneath the Triangle. That is, 1. Rood, 36. pearches, and $\frac{1}{2}$. of a Pearch.

How mixed Figures are measured.

Land compound of circles, or his parts.

I thinke none nowe will doubt howe these two figures following are measured, because the are made of portions or partes of Circles, whose measure is before sufficiently opened,

nes, the one consisting of two halfe Circles, & a Quadrangle: the other being the portions of the Circle, m. o. doubled.



If any euill fashioned land chaunce to be measured, which requireth to be brought into many triangles, to saue labour, ye may adde some portion vnto that, and make it square or otherwise. So let it then be measured: and after, from the product pull away that ye added: the remaine is the Content.

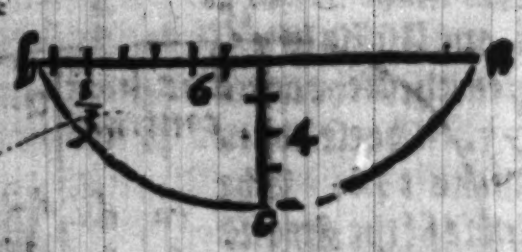
To find the content superficiall of steeples, Columpnes, Globes, and their parts.

TO the Arithmetrician I say: for picked Steeples, multiply the whole syde in halfe the Circumference of the Base, adding the plaine of that Base. For pillers, augment the Circumference of the Base in the heights, putting to the plaine of both Bases. For Globes, the Diametre in the Circumference multiplyed: euen so of Fragments or parts. Let them that be voyde of Arithmetike enter my Table of account following, with such numbers as I nowe willed the Arithmetrician to multiplie, not forgetting what I haue before written. So I serue their turne. To measure Steeples, Columpnes, Globes, &c.

The Art of measuring

Or thus by the rule of proportion the partes of a Globe are found.

To measure parts of Globes



Suppose a. b. c. to bee a peece of a Globe, and 4. to be a proportiõ of the diameter, the whole being 14. Thus I say, 14. the whole Diametre giueth 616. the Content superficiall of this Circle: what shall 4. bring. So haue ye 176. which is the content of that peece.

To find the Diametre by some knowne portion thereof.

To find the vnknowne Diametre of a Globe.

If ye be ignorant what length the Diametre of the Globe is, whose portion ye haue, the height or part of the Demetient being 4. Foote, augment halfe the Line a. b. which is 6. ½. in himselfe, and the product diuide by 4. So haue ye 10. to be added to 4. which maketh 14. the whole Diametre.

The true measuring of Mountaines and Valleys.

The vi. Chapter.

To measure Mountaines.

First ye shall measure the circuit of the Foote, or Base of the Mountaine: then the compasse of the Summitie or top, adding them together. So shall ye do of the Ascenses, that is, the going vp from the foote to the top, ioyning the measure of the longer and shorter in one. Now take the halfe of the circuit added, and the halfe part of the Ascenses ioyned, and enter your Table: there shall ye see the Content.

Ensample.

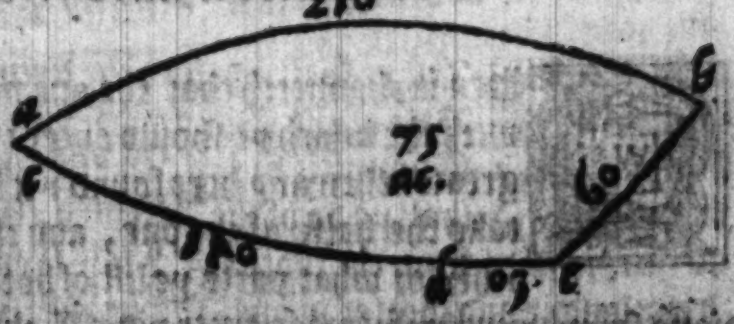
Ensample.

A b.c. is the Mountaine: a.c. the circuit of the Base, being 100. Pearches. b. the top 16. Pearches. Which ioyned together make 116. b.c. & one Ascense is 55. pearches: the other 75. Theese added make 130. The halfe of the circuits is 58, the halfe of the Ascenses 65. With these two summes yeshal enter your table of account, where ye shal find 23. acres, 2. rodes, and 10. pearches, the true content of this figured hill. Figure of a Mountaine.

Of the Valley.

As in the Mountaine ye measured the circuit or compasse of the Base or foote: so here contrarie ye shall méet round about the circuit or compasse of the height of the Valley. And as ye got the measure or compasse of the top of the mountain: so measure the circuit of the Depth of the Valley. In like maner as ye measured the Ascense, that is, the going vp from the foote to the top: so measure the Discense or going downe of the Hill, to the depth of the Valley. The rest all worke, as I haue shewed in measuring the Mountaine. To measure a Valley.

For more plainnes, behold this ensample or figure. Figure of a Valley.



If ye lay together the Circuites of the Height and Depth which is 210. and 30, taking the halfe parte of

of those two Circuites, making an 120: then the two Ascenses 140. and 60. added in one product 200. the halfe thereof being 100: with this and 120. the other halfe of the circuite, ye may enter your Table. That doing, lo 75. Acres.

How the Table of account now following, is to be vsed.

When you haue gotten a conuenient Length and Breadth, (as I haue aboue declared by diuerse Triangles and other figures) then you shall enter this Table. Seeke there the Length, and most number of Pearches in the higher margine, which beginneth at 1. and endeth rightward at 40. Looke the other summe of Pearches (I meane the Breadth) in the right side and hanging margine, from 1. descending to 30. Now at the meeting of the lines, where the one answereth the other directly in a square, you shall find the Acres, Roodes, Dayworkes, and Pearches. Note that the first number set on the left side, and vpper part in any square, signifieth the number of Acres. The figure 1. set in the vpper part, and right side, both betoken a Roode: the figure 2. there two roodes, 3. three roodes. And the figure in the left side beneath, signifieth a Day worke, or dayworkes. A figure in the lower part rightward, declareth Pearches.

A Declaration adioyned

What is to be done when numbers, with which you should enter, exceede your Table.

When it chanceth that the one number or both, with the which ye should enter this Table, are greater then any here found: it behoueth you to take the halfe of the one, and the whole of the other, or what parts ye list of both, most commodious for your purpose, and so enter your Table. Looke then what is there found, and it shall beare his name of the partes

multiplied in themselues.

Ensample.

Suppose the number with the which yee should enter your table to be 103. Pearches in length, and the Breadth 60. neither of these may be found in the margines: wherefore I take the third part of an 103. which is 34 Pearches, and one remayneth.

The halfe 60. that is 30. I finde with entring them at the common meeting 6. Acres, 1. Roode, and 5. Daywarkes. This summe must haue his Name of the parts augmented in themselues. I tooke the thirde part of the one, and halfe the other number, therefore 2. must be multiplied in 3. or contrarie: so haue ye sixe, which signifieth that ye haue found by entring, but the sixt part of the number ye should finde. Wherefore I must take this summe tofore found (being 6 Acres, 1. Roode, and 5. Daywarkes) sixe times as much. So haue yee 33. Acres and 1. Roode. For the Pearch remayning in the length, reckon him in the Breadth, (as is afore declared) in the fift Chapter of the Remaines: So haue ye 60. Pearches more to be added. So the encrease of these two numbers, 103. and 60. amount to 38. Acres, 2. Roodes, and 5. Daywarks. Thus any maner Length and Breath is reduced to this table following, which sufficeth.

Looke what I haue shewed in the chapter of parts, that vnderstād here of whole pearches least subtracting, &c.

Thus with few wordes is ended the certaine measuring of all maner Land, touching the Superficiall Contents. Wherefore now shall follow the true measuring of Timber, Stone, Steeples, Pillars, Globes, according to their Crassitude.

Such as are altogether ignorant of Arithmetike, may reckon by our English coyne, allowing for euery pearch in length or breadth a penie, and so euery Marke makes an Acre, euery Noble halfe an Acre, euery fortie pence or halfe Noble, a Roode, and euery pennie a square Pearch. And so by Memorie without tables, may in some rude and grosse maner, cast vp reasonable iust the true contents of all Closes, Medowes, Marshes, Hilles or Valleys.

To the Reader.

IT commeth commonly to passe, that Carpenters, Masons, and such like Artificers, are put either to measure Timber euery way square, or squared logs broder on the one side then on the other: yea, many times mutilate or vnperfect stuffe. Sometimes three, fiue, tenne, or twentie square in the head, and so through: oftentimes round Stone or Timber with hollowed, &c. Afore I shew vnto them what must be done with such peeces of timber or stone to get their true measure, my desire shalbe, that such Craftsmen wil leave to be headie or selfe willed: yea so greedily to sticke to their corrupted rules, that vtterly they refuse to be taught.

Both learning and experience declareth vnto me, that the Grounds which the best of them haue, are false. To open how and where, it needeth not: neither doth it appertaine to instruction, onely it may suffice him that liketh the true way, here to receiue it appointed to him. Yet to satisfie & content him which will not beleeue any such errours or false grounds to bee, I say (and truly) that the Ruler of Timber measure, which the most part of them hath, is not made by right Art. Besides that, their craft in seeking the Square of some timber is very false. They vse in measuring, to lay the broder & narrower sides togither in a summe, and to take the halfe of that number for the Square. Then they seeke this vntrue Square vpon the false Ruler, and so measuring the Timber, they conclude of it vntruely.

To the Reader.

As this is corrupted, so are other Groundes which they take to bee infallible. Nowe to the purpose: touching the correction of those Errours, with other not mentioned, whereby true measuring may ensue, this way shall be taken. After I haue opened how you must handle all such fashioned Timber (as afore is spoken of) there shall follow a Table, in which ye may find (as I wil declare) the Square of any Stone or Timber. That knowne, it is requisite to haue another Table immediately following, which may appoynt to all true Squares from 1. to 6 Inches, the iust length to make a Foote euery way square. With the length agreeable to your Square, your Logge must be measured. And as oft as yee finde it from the one ende to the other of your Timber, so oft yee may conclude the Foote square to bee contayned in that timber Logge, or Stone: that is, so many square Feete there to be included. This Table of Timber measure standeth in the place of a good Ruler, well decked with true measures. By this ye may make or correct Rulers at pleasure, as after appeareth.

In a Foote square is contained 1728 Inches.

Now orderly followeth the true measuring of all fashioned Timber or Stone aforenamed.

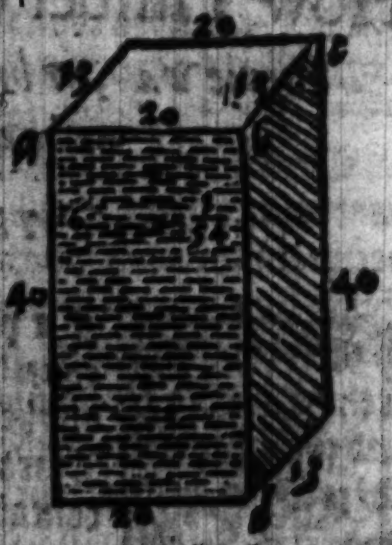
How Timber or Stone foureſquare euerie way, or broder on the one ſide then on the other, is meaſured.

The vij. Chapter.

IF a peece of Timber or Stone, bee either equally ſquare, or broder on the one ſide then on the other, ye ſhall take the iuſt meaſure, I meane, how many Inches the broder ſide containeth: euen ſo of the narrower. This done, ye muſt ſeeke in the table of ſquares following, the meaſure of the broder ſide of the Timber or Stone, in the vpper margine of that Table. Then looke for the number of Inches, of the equall or narrower ſide in the right part and hanging Margine. At the common meeting where the one number anſwereth directly to the other, there your true Square ſhall appeare. This Square ſo found ſhall be referred to your Table of Timber meaſure: in the which ye may plainly ſee (if you runne downe by the left Margine vntill your Inches ſquare appeare) howe many Feete or Inches of your Ruler belongeth to a Foote ſquare. As often as that meaſure there found is contained in the Timber or Stone, ſo often and as many Feete ſquare yee may conclude (without doubt) the peece of Timber or Stone to haue.

Ensample.

Suppose this squared Timber or Stone a.b.c.d. were to be measured, the broder side a.b. 20. Inches, the narrower side b.c. 13 Inches, the length 40. Inches. Nowe I must seeke the broder side 20, in the vpper Margine of the Table. The narrower side 13, must be found in the right side and hanging margine. At their common meeting, 16. Inches, and ½. part of an Inch shal appeare. This true square must be searched for in the Table of Timber measure. Therefore looke for 16. in the Margine of this Table. In the squares with him rightward, ye shall find 6. Inches, and ¾. which is three quarters of an Inch. Somedeale lesse of your Ruler then 6. and ¼ layd out vpon the Timber maketh a Foote Square. And that measure so directly handled, is contained in the Length of your Timber fiue times. Wherefore affirme fiue foot there to be, beside that is left ⅘. part of a Foot. Note because the Squares at all times (in this Ensample) rise not to euen Inches, but sometime to odde parts: therefore according to your discretion, adde or take away some part more or lesse in setting forth the Foote Square, as aboue is performed.



It were intollerable tediousnesse, yea impossible to set forth the true quantities of Timber measure, to all odde Quantities of Squares. The discreete handling of these, the witte shall bring to a sufficient exactnesse.

Of Timber or Stone, 3. 5. 10. 20. or mo sides Square, &c.

The viii. Chapter.

When Timber hath diuerse equal Squares in the head, and so through: first measure all the square sides round about the head or end of the Timber. Then take halfe the number of the whole measure for one breadth.

Then measure from the Centre (which is the middle of the head, or end of the Timber) to the middest of the Square side betweene the two Angles, and take the measure of that distance for the other Breadth. Now resort with the measures of these two Breadths, (as before) to the Table of Squares: seeking the bigger number or Breadth in the vpper Margine, and the other lesser in the side Margine. With the Square there found, haue recourse to the Table of Timber measure, and do as I haue instructed.

Ensample.

Admit this small peece of Timber 5. square e.f.g.h. should be measured, euery side being 12. Inches. If ye adde togither in one summe all the fiue sides, they make 60. Inches. The halfe is 30. that serueth for one breadth. Then the Line e.f. which goeth from the Centre or middest of the square to the middle of one side, is 8. Inches. The two numbers 30. & 8. must be sought (as before) in the table of Squares following. At the common meeting, your square shal appeare 15. Inches, & ½. This square 15. seeke in the Table of Timber measure. There ye may see right with it

7. Inches,

7. Inches, and ½. Now because of ½, the odde quantitie of the Square aboue 15. Inches, lay something lesse. Then see how oftentimes that measure (so with discretion handled) is from the one end of your Timber to the other: and affirme so many times a Foote square there to be, as that measure is found in the length of your Logge.

How round and hollow Timber, steeples, Pillers, Globes, &c. are to be measured.

The ix. Chapter.

First gird the Log round about with some Line: then diuide the Line which compasseth that timber in two equall parts: keepe the one part for the bigger Breadth. After, ye shall diuide againe that whole length (the twentie & two part cast away) in three partes, and take the halfe of one of them for the other narrower breadth. With the measures of these two Breadths hast to your table performing all things as afore is opened.

Ensample.

Suppose this little peece of Timber, i.k.l.m. were to be measured, the compasse or girding 36. Inches, the halfe of that is 18. being the one breadth: then the third part of 36. is 12: the halfe of it is 6. which is the other narrower Breadth. with these two numbers 6. and 18. enter the Table of Squares following, and so the Table of Timber measure. At the last (all things performed as before) yee shall find in this round Log, the Length l.m being 18. Inches, 1. Foote, and ½. part of a Foote. This is sufficient for all such like.

A note of hollowed Timber.

IF it chaunce that hollowed Timber be to be measured: measure the whole Logge as though it were not hollow, as aboue is declared. Then measure the narrower and broder side of the hollow, and see what is contained in that, as though it were massie Timber. Now pull out the Content of it, from the whole aboue measured: the remaine of force must shewe what Timber is included in that hollowed boote.

I Am vnable in fewe wordes to expresse to the vnlearned, by what meane Pyramidall, or picked regular Steeples of all fashions are measured. Also how Pillers, how the Content of Globes or Bowles are searched, vnlesse the Art of numbring were taught. That being knowne as thus (as now followeth) I teach.

How the crassitude of picked Steeples is knowne.

MUltiplie the plaine of the Base in the third part of the height: so yee haue the Crassitude. Or multiplie the Content superficiall (found as I haue instructed) in the height of the Steeple, taking for your purpose the third part of that product.

How the Content of Pillers is knowne.

Encrease the Base plaine in his Attitude or Height: so haue ye your desire.

How the Cubicall bodies of Globes are searched.

The Content Superficiall found, (as I haue opened) must be multiplied in the first part of the Diametre: the product is that ye require. Or the third part of the superficiall Content in halfe the Diametre. Or multiplie the plaine of the Circle in the whole Diametre: then take two thirde parts, which added make the Crassitude.

Of the halfe Circle.

His Superficiall Content multiplied (as I sayd) bringeth the magnitude of him. If any man require ensamples of these last matters, or more sufficient handling: let them resort vnto my bookes published of Geometrie, where they shall be satisfied. These little appertaine to Carpenters or Masons: therfore not by ensample declared.

A Generall Note.

When thou shalt be put to measure some Bodie without order or fashion, lacking part of his Square, or hauing more then his Forme: if it lacke, thou shalt make it perfect by obseruing diligently the running together of the sides. The partes wanting shall bee measured as though they were there, which portions must bee taken from the whole Bodie measured.

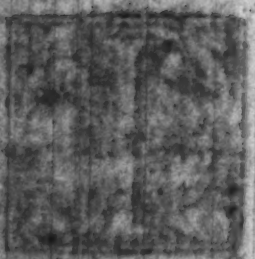
Also when there resulteth any more then the forme or Regular Square: first measure the square Bodie: then the crassitude which aboundeth. All put together, doe shew the whole irregular Bodie. This sufficeth.

A Table to find the iuſt Radix or Square of any Timber or Stone.

IT behoueth you to know that this Table following is made for the true ſquare of any inner Timber. Therefore vnderſtand that the numbers from 1. to 40. ſet aboue in the high Margine, betoken the Inches of the broader ſide of the Timber. And the numbers from 1. and ſo downward to 30. put in the right part and hanging Margine of this Table, ſignifie the Inches of the narrower ſide: and to cõclude briefly, the Element or figures ſet in euery ſquare roome, betoken the iuſt ſquare. The bigger figures leftward in euerie ſquare place, ſignifie the whole Inches. And the other Leſſer rightward in the ſame ſquare diuided by a line the parts of Inches, as $\frac{1}{2}$. &c.

This firſt Fraction toward the left hand betokeneth one halfe part of an Inch: the other two fifts of an Inch, and euerie figure or fraction hauing a poynt adioyned vnto him, ſome deale leſſe then that part is: as this part, $\frac{1}{2}$. repreſenteth ſcant halfe an Inch, a verie little quantitie leſſe. And if it had two pricks by him, he ſhould haue declared ſome quantitie more: as this other fraction or part, $\frac{2}{5}$. which is more then two fifts, a ſmall deale.

It had not beene needful to haue put the parts of the Square ſo preciſely as they are here: neither is it requiſite ſo curiouſly to take them.



The x. Chapter.

THis Table (as ye see) is deuided into two Columpnes or Rowes: the one verie short, the other longer. In the head of the first, I haue put this word Foote: in the second Rowe, Inches, and Parts: to signifie Feete, Inches, and parts of Inches. The Summes in the Margine and left part of the first and second columpne, declare the quantitie of the square of Timber or Stone, from 1. to 36. Inches square. Within the Rowes you may find the iust length to a Foote square, if ye enter into them in right order according to the Square.

Ensample.

SUppose the Square of your Timber were 7. Inches, and that ye desired to know what measure or length of the Rudder would make a foote square: seeke in the left margine seuen Inches: and with him in that order toward the right hand, ye shal find 2. foote. 11. Inches, and ½. of an Inch. Note because the fraction hath a prick by him; it wanteth some small quantitie lesse then ½. of an Inch. If it had 2. pricks or points thus ½: it should signifie somtitle quantitie more. Neither maketh it matter whether ye obserue this pricking or no, the quantitie is so little to be added or pulled away.

Note What hath bene spoken of timber, the same also is to be vnderstand of stone, likewise to be measured.

Thus is finished the measuring of timber.

How Tables, Boordes, Glasse, or any such like, are measured, according to their length and bredth, onely to the Foote square.

The xi. Chapter.

This thing is perfourmed by the help of a large Table following, diuided in fiue small Tables, and as many Wargines. The first and left Wargine beginneth at $\frac{1}{4}$. which is one quarter of an Inch, and extendeth to 6. Inches, as ye may plainly perceyue if ye runne downe by that Wargine. This hath his Table on the right fide adioyning vnto him. The other taketh his beginning at 6. Inches, $\frac{1}{4}$. and endeth at 12. hauing his proper Table also. The third from 12. $\frac{1}{4}$. to 18. And so from 18. $\frac{1}{4}$. to 24. from 24. $\frac{1}{4}$. to 30. The last Wargine is from 30. $\frac{1}{4}$. to 36. and there endeth.

Of this that is sayd, you may gather that euery Wargine hath his Table on his right side. Also you must know that in the top, & beneath; I haue put (as in the table of timber measure) these words Foote, Inch and parts, to signifie Feete, Inches, and parts of an Inch. Whensoeuer ye list to measure Bord, Glasse, or any other such, with the Breadth of it, enter this Table, and seeke that Breadth in his proper Wargine: there ye shall find in right order how many Feete, Inches, or parts of an Inch, belong to a Foote square. So often as the measure is in your Glasse, iust as many Feete haue yee in that Bord, or such like. If the Breadth exceede this Table, then deuide the Breadth in parts, and worke as is and shall bee declared. So the ingenious applyeth this Table for all maner breadths, most exactly.

Exsample.

To Yd			To Yards			Yd Par			Yd Par			Yd Par			
1/4	48		6 1/4	1	11 1/25	12 1/4	11 3/4		18 1/4	7 7/8		24 1/4	5 15/16		30 1/4	4 1/4
1/2	24		6 1/2	1	10 1/25	12 1/2	11 1/2		18 1/2	7 4/5		24 1/2	5 7/8		30 1/2	4 5/7
3/4	16		6 3/4	1	9 1/5	12 3/4	11 2/7		18 3/4	7 2/3		24 3/4	5 3/4		30 3/4	4 2/3
I	12		7	1	8 4/7	I3	11 1/16		I9	7 4/7		25	5 2/4		31	4 5/8
1 1/4	9	7 1/5	7 1/4	1	7 7/8	13 1/4	10 7/8		19 1/4	7 1/2		25 1/4	5 2/3		31 1/4	4 5/8
1 1/2	8		7 1/2	1	7 1/5	13 1/2	10 2/7		19 1/2	7 2/5		25 1/2	5 5/8		31 1/2	4 4/7
1 3/4	6	10 2/7	7 3/4	1	6 4/5	13 3/4	10 1/2		19 3/4	7 2/7		25 3/4	5 5/8		31 3/4	4 1/2
2	6		8	1	6	I4	10 2/7		20	7 1/5		26	5 1/2		32	4 4/7
2 1/4	5	4	8 1/4	1	5 3/7	14 1/4	10 1/2		20 1/4	7 1/8		26 1/4	5 1/2		32 1/4	4 1/2
2 1/2	4	9 3/5	8 1/2	1	4 15/16	14 1/2	9 7/8		20 1/2	7 1/5		26 1/2	5 3/7		32 1/2	4 3/7
2 3/4	4	4 4/11	8 3/4	1	4 2/5	14 3/4	9 3/4		20 3/4	6 15/16		26 3/4	5 3/8		32 3/4	4 3/8
3	4		9	1	4	I5	9 5/8		2I	6 6/7		27	5 1/7		33	4 1/3
3 1/4	3	8 1/5	9 1/4	1	3 4/7	15 1/4	9 3/7		21 1/4	6 4/5		27 1/4	5 2/7		33 1/4	4 1/3
3 1/2	3	5 1/3	9 1/2	1	3 1/7	15 1/2	9 2/7		21 1/2	6 2/7		27 1/2	5 2/7		33 1/2	4 2/7
3 3/4	3	2 2/3	9 3/4	1	2 4/5	15 3/4	9 1/9		21 3/4	6 5/8		27 3/4	5 1/7		33 3/4	4 2/7
4	3		I0	1	2 2/5	I6	9		22	6 1/8		28	5 1/8		34	4 1/4
4 1/4	2	9 2/5	10 1/4	1	2 1/20	16 1/4	8 5/7		22 1/4	6 1/2		28 1/4	5 3/32		34 1/4	4 2/15
4 1/2	2	8	10 1/2	1	1 3/4	16 1/2	8 2/4		22 1/2	6 3/8		28 1/2	5 1/16		34 1/2	4 1/7
4 3/4	2	6 2/3	10 3/4	1	1 3/8	16 3/4	8 5/8		22 3/4	6 1/5		28 3/4	5		34 3/4	4 1/8
5	2	4 4/5	II	1	1 1/11	I7	8 1/2		23	6 1/4		29	5		35	4 1/8
5 1/4	2	3 3/7	11 1/4	1	1 4/5	17 1/4	8 1/3		23 1/4	6 1/6		29 1/4	4 7/8		35 1/4	4 1/7
5 1/2	2	2 1/5	11 1/2	1	1 2/3	17 1/2	8 1/5		23 1/2	6		29 1/2	4 7/8		35 1/2	4 1/7
5 3/4	2	1 1/23	11 3/4	1	1 2/7	17 3/4	8 3/12		23 3/4	6		29 3/4	4 5/6		35 3/4	4 1/7
6	2		I2	1		I8	8		24	6		30	4 4/5		36	4

Ensample.

Suppose I haue a pane of Glasse or a Bord, whose breadth were 22. Inches, $\frac{1}{2}$. the length 16. foote. In the fourth Margine, I find this breadth, 22, and $\frac{1}{2}$. And euen with it in the Table rightward, I see 6. Inches, $\frac{7}{7}$. So much of my Ruler wanting some small quantitie, maketh a foote.

Now because in the length of my Bord (which is 16. fwt) that measure is found 29. times, and $\frac{1}{2}$. parts: I conclued 29. Foote there to be, and two third parts of a foote Square, according to the Length and Breadth. I said (wanting some small quantitie) because of the poynt ioyned to this fraction $\frac{2}{12}$ which is put to diminish the Fraction some little thing, as is declared plainly in the other Tables before put forth.

HE that desireth to measure Chamber Flores, Pauements, or such like, let him onely multiply the Breadth with the Length, so the product sheweth the Content.

Ensample.

IF there were a Pauement 200. Foot long, and in Breadth 50. I must needes conclude (by multiplication of the length in the breadth) three to be contained 5000. Foote.

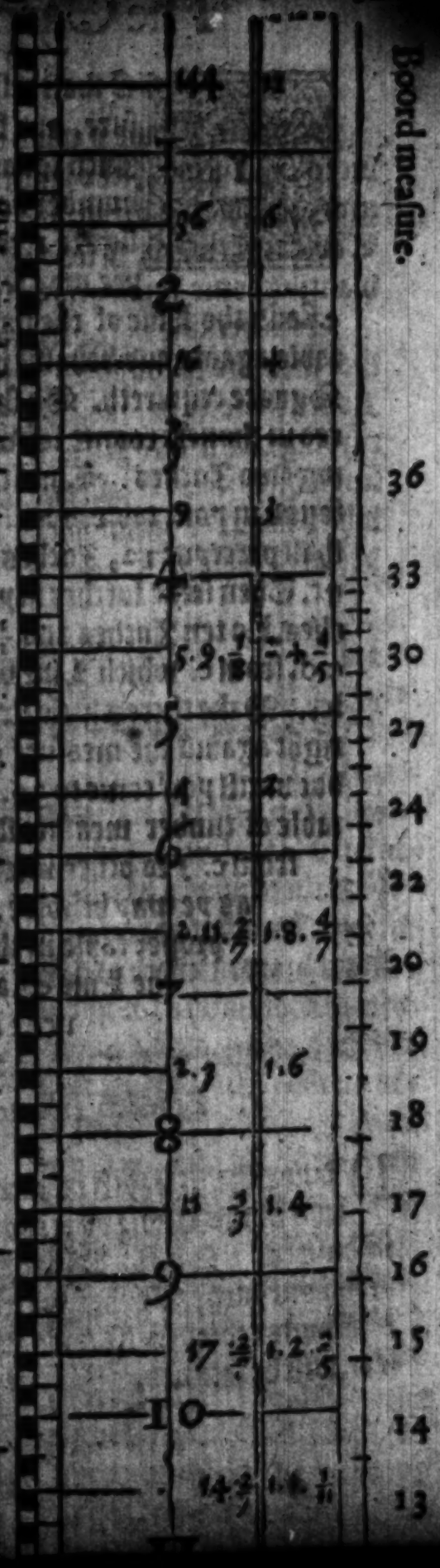
Or thus without Arithmetike, when the Breadth exceedeth the Table.

DIuide the Breadth in parts (as is opened in the Declaration of the Table of account) and worke as I haue before instructed. So for Pauements all manner wayes it serueth your turne. Of this matter to put forth Tables, were superfluous tedious nesse and folly. The ingenious with these few, will be satisfied.

The

The Carpenters Ruler.

The face of the Carpenters Ruler, figured with the true measures and other things necessarie.



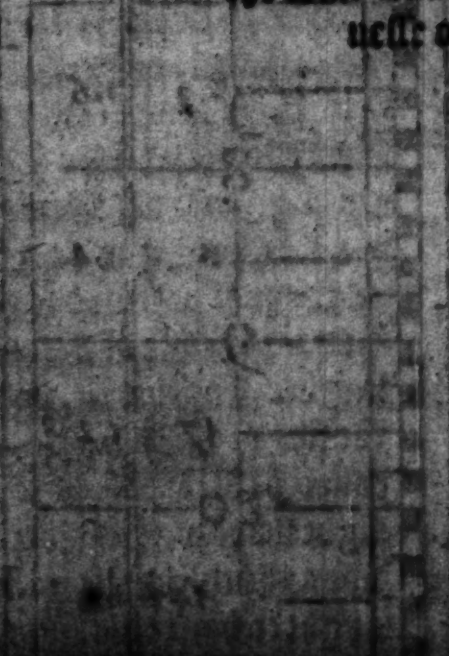
The xii. Chapter.

BEcause the effect of this ruler is aboue declared by tables, an instrument also well knowne and common among good Artificers, I will not spend many words in opening it. Behold the figures & learne by them howe yes ought to make, and commonly to decke your Ruler, both with timber, and boord measure.

Ensample.

Admit the Ruler to be a.b. c.d. well plained, 12. Inches long, a quarter of an Inch thick, & two Inches in breath. Truely it were more commodious, if it had two Foote in length. This Ruler here imagined, but a foote in length is deuided first in 12. euen parts called Inches: the euery Inch in half, or two equal portions: each half in two quarters: euerie quarter in foure or two parts at the least: as in this ensample. Then are the figures placed from 1. to 12. manifesting the Inches. Thus your

YE shall resort to your Table of Timber measure, and seeke how many feete belong to one Inch square: there ye shall find 144. This number note, write, or rather graue, where this figure 1. representing one Inch, is figured, as ye may see in the middest betweene the Line e. f and the Line of the figure g. h. This done, resort to your table againe, and beholde how many feete and parts 2. Inches Square requireth. So shall ye find 36. Foote, which is placed in the next roome leftward vnder the Character 2, signifying two Inches. Thus the reste, Feete, Inches, and parts, found in your table, vntill you come to the 12. Inch, where ye shall perceiue 12, Inches onely to be set in his Proper roome, &c. Then seeke further in your table what belongeth to 13. Inches. Lo ten Inches and $\frac{1}{7}$. This must be numbred in the line e. d. from e. which Line betokeneth the thicknesse of the Ruler. Make there a little strike, vpon that grossenesse, euen right against the measure 10. What need many wordes? Thus doe vntill you come to 36. Inches, and that is noted (on the table of timber measure sheweth) right with 1. Inch, and $\frac{1}{7}$. from e. No otherwise is performed of boord measure, as ye may beholde, set forth by the helpe of this proper table in the Square roomes beneath the Line e. f and also the other thicknesse or Line b.



The xiij. Chapter.

The Line of heights vpright.

THis other figure i. k. l. m. is the backside of your ruler, hauing in the middest of it a Geometricall quadrant n. o. p. q whose making in fewe wordes is thus expressed. The line or breadth of your ruler n. o. that line o p. p. q. q. n. ought to bee of one equall iust length, cutting eche other squitewise. And frō ꝑ centre n. vnto p. is drawne another line, which is called ꝑ line of bright. So is o. n. the line of leuel, q. n. the line of heights vpright. This knowen I opē my compasse, one foot remaining in ꝑ centre n: the other extended in the line of leuel almost to o. making a circumference to q. n. which is a portiō of a circle named a quadrāt: & ought to be diuided into 90 equall parts, as ye may beholde, euery of the called a degree. Ye may diuide ꝑ lines o. p. p. q. named ꝑ Scale, eche in 12. as here, or in 60: yea in 100. equal portions is most meet for the vse of shadows, heights, lengths. &c. Note ꝑ the side or base scale o. p. is called ꝑ contrary shadow p. q. right shadow. Remember that vpon the thickenesse. m. k. ye ought to haue two fine equall

The making of a Geometrical quadrāt

Note these three principal lines.

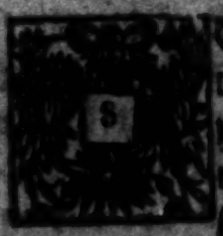
The deuided sides o. p. and p. q. are called the Scale.

Carpenters Ruler.

The common vſe of the Carpenters Ruler, touching the Face afore put forth.

The xiiii. Chapter.

The eight Chap. ſheweth how the true ſquare is found.



Suppoſe a peece of timber to be maaten, whoſe true ſquare is 7. Inches, this ſquare appointed you to the figure of 7. in the line g.h. vnder whom rightwards in the place aſſigned to Timber meaſure, is written 2. foote 11. Inches, $\frac{1}{7}$. As often as that meaſure is found in the length of your Timber, ſo many foote of Timber is in that peece.

Another Enſample.

Imagine your Square to be 22. Inches: ſeeke in the Line a.c. Note then howe much of your Ruler is left from that to the ende of your Rule c. and ſo much belongeth to a Foote. Therfore lay out the meaſure vpon your Timber, and reckon how many times ye may find it, frō the one to the other of your Log: for ſo many foot of Timber is there. Euen thus of boord. Seeke the breadth vpon your Ruler, in the rowme or place of boorde meaſure, and immediately before your eyes there remaineth what is to be laid out to make a iuſt foote of boord.

The vſe of the principall lines in the Geometricall Quadrant on the backeſide of the Ruler, and firſt of the leuell Line.

The xv. Chapter.

It behoueth you to loke through your ſights n.n. placed in the thickneſſe or line k. m. a fine thred and plummet falling atlibertie out of the Center. If this plummet and thred chance preciſely on the line of leuel (which is n.o.) what ſoeuer ye ſee through the ſights, is leuel with your eie: if other-

wise the thing that ye looke vnto is not leuell, neither may it shew them the height or leuell of your eye: for if the plummet fall to you warneliche, it contrarie.

How by the line of Leuel to foresee whether the water of any spring or head is possible to be brought to a place appointed, and also to iudge the holesomnesse of it.

The xvii. Chapter.

Shall go to the head or spring, and set your Ruler to your eye (being in height equal with the water) so that the sight and plummet fal precisely vp the line of leuell. Now if through the sights ye may see aboue the place, know and iudge the water possible to be brought, if your sight fall vnder: impossible. It commonly comonly so passe when the place to the which ye would haue Water conueyed, is of any great distance from the head, then Hilles, Valleys, and such like impediments, let the Line vsuall to haue his free course: wherefore this remedie is prouided. At the head of the Spring, ye shall looke thorow the sights (as before) and note a marke in the next hill toward the place, then go to the marke in like maner obserue another in some hill: so forth vntill by any of them ye may perceiue the place desired. If then your sight running through the pinnes of your Ruler, (the eyen ever falling on the Line n.o.) exceed that place, the conueying of your water is possible. Otherwise not.

Now by the way briefly ye shall be instructed how ye may know the holsomnesse of water.

How good water is knowen.

TAke a clean pot, and put water in it: so set it on the fire: after a little boyling, powre it out: if then no filth remaine in

the bottome of the pot, it may be iudged the holsommer. Or thus. Let fall drops vpon metall, or rather on Glasse (one of them being polished) and suffer them to vpe by a little, if after there remain no spot or figure it is a good token. Moreouer, if your water be sweet, your eyes light, it is of little weight, it followeth the water to be holsome for the vse of man.

Of the Line of height.

WHensoeuer the Thred and Plummet doe chaunce iustly on the height which is n. p. the Altitude or Height that ye see is euen with the distaunce from the middle of your Foote to the neither part directly vnder the Toppe equall with your sowing. adding the Height of your Eye betwixt. Knowe that yee must euer stande vpright with backe and Neche, your Feete iust together, the one Eye closed, &c.

The Line of vpright Altitudes.

I Hope also any thing plumbe vpright when the thickenesse of your Ruler i.l. is euen thereon, the plummet then at libertie falling on q.n. named the Line of Heights vpright. Now followeth the vse of the Scale.

To search out Heights by the Scale vvith the ayd of tvvo places.

The xviii. Chapter.

LEt the Thred and Plummet fall in the one, on the 12. points: in the other Station, on the 6. of the right shadow: double the distance betweene the two places, the summitie appeareth from that part of the thing measured, which is equall in height with your eye.

Or

Or the one in the 12. the other in 8. of right shadow: then triple the distance. The one in 12. the other in 6. of right Quadruplate, the space. The one in the 12. the other in 6. of the contrarie shadow, then the space betweene both the Stations is equall with that ye measure, euer vnderstanding from your eye vpward. Euen that same commeth to passe, if in the one the thred be found vpon the 6. of the contrarie, in the other on the 4. of the same, or the 4. and 3. of the contrarie. In all these the spaces are Equall with the Altitudes. So then in measuring the distance betweene the two places, ye haue the height from your eye vpward, putting to it the length from your sight downward, the whole Altitude appeareth: the Base being Equall with your standing.

I would not haue you ignorant here how to know lengths which be in height not easie to come vnto. For (as before) get the height of the toppe, the altitude of the base or longest part of your length. Subduct the lesse height out of the more, of force your desired length remaineth. Or thus: Let the plummet and thred fall in the 12. Marke your place: go in towarde the thing (the thred as it was) vntill ye see the base of that length: the distance betweene the two standings, is vnoubtedly the Length.

How lengths in height are knowne.

How with the Scale direct or vpright heights by their shadowes are declared.

The six. Chapter.

Vrne your left side vnto the Sunne, suffering his Beames to peare both your sights q. r. placed (as afore is sayde) in the thicknesse or line k. m. The Thread or Plummet then hanging at Liberte out of the Centre n. sheweth as well

the Degrees of height to be counted from o. as the parts of the Scale cut. If your thred be found in the 12. part of line of leuell, shadowes of all things being perpendicular required, are equall with their bodies. If the plummet with the thred be perceyued cutting the parts next to the sights, which I name points of the right shadow, then euery thing direct is more then his shadow, by that proportion which 12. exceedeth the parts, where the thred was found. If it fall in 1. that is the first part of the right shadow, take the shadow twelue times to make the height. In two, that is the second part, fyue times, in the third, foure times: in the fourth, three times: in the fift, twise: and ½. of the shadow, in the sixt twise, in the seuenth once, and ½. in the eight once, and ⅓: in the ninth once, and ⅓. In the tenth once, and ¼. In the eleuenth ye shall take the shadow once, and ⅓. part of it.

Right shadow.

If the Art of numbring were had, I would will you to multiplie the length of the shadow by 12. and the product diuide by the parts in the which ye found the thred.

Contrarie shadow.

But and if it be in the parts of the contrary shadow, augment the length of the shadow with the parts declared by the plummet: and the encrease diuide them by 12. so commeth the altitude also.

Thus the composition and whole appliance of the Carpenters Ruler is shewed: therefore, somewhat shall be now said of the Squire.

I am not ignorant that the common vse of him is better knowne then I can with many words expresse, wherefore I leaue to write in that behalfe. Notwithstanding I will declare how heights and Lengths are taken, &c. matters rare and knowne of few Artificers.

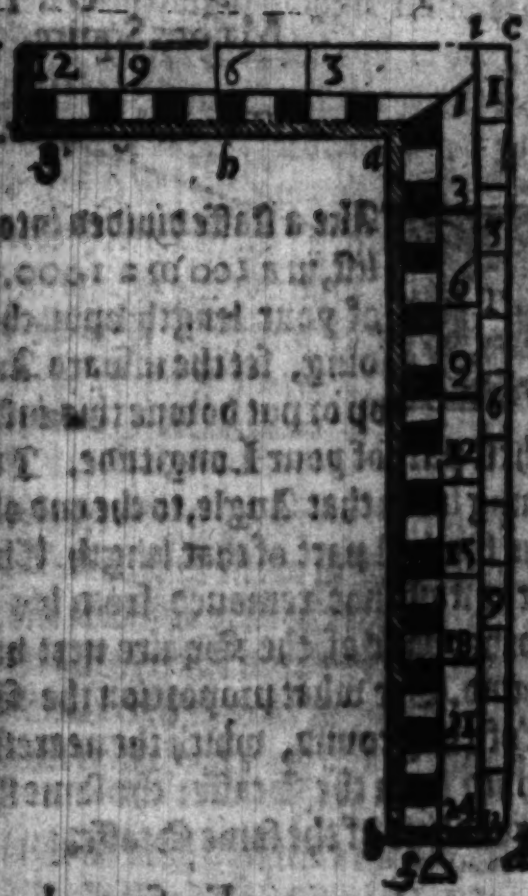
Also by tables to get a true knowledge of the day houre, and that diuerse wayes, with the helpe of the Squire, as is opened in my generall Prognostication augmented in the yeare of our Lord 1556.

What

What length the sides of thy Squire ought to be, and the division of him.

The xxx Chapter.

I Need not to put forth the exact making of this Instrument so well knowne. Lo therefore the figure. One side supposed two foote from the inward Angle: and the other a iust Foote from the same. The longer a. b. inwardly diuided from the Angle a. vnto b. into 24. equall principall parts, and euery of them into a lesse (if ye list) eche containing 10. minutes. Also the five c.d. in the outward contrary, plain from the top c. vnto d. is diuided into 12. euē portions: and againe (if ye require exactnesse) euery of them into 6. each of value 10. minutes: Beholde a line and plummet falling from e. to f. a parallel to c.d. and a.b. Thus this squire is well framed for the vse of diuerse Tables put forth in my generall Prognostication, and also for the finding of Altitudes and Longitudes, which here I purpose now briefly to open.



How by the Squire heights are knowne.

ALtitudes or heights are found, the line of plummet centred in ỹ 6. point, cutting h. the middle of a.g. The mone-

sixe sights placed in a groue parallell from that line, and vnlike, as is opened of the line of height, in the back of my ruler.

Hovv Lengths in plaine Ground are *searched by the Carpenters or* Masons Squire.

The xxi. Chapter.

Take a staffe diuided into certaine portions as pleaseth, in a 100. or a 1000. parts. At the beginning of your length vpon the verie top directly standing, set the inward Angle of the Squire: lift vp or put downe this instrument vntil you see the farthest part of your Longitude, I meane vntill your sight running from that Angle, to the end of your Squire, come vnto the farthest part of that length. The Squire so remaining, and the staffe not remoued from his height. Marke where the other ende of the Squire next vnto you noted vpon the Ground. See what proportion the Staffe then beareth to the part of the ground, which the neerest end of the Squire pointed vnto from the Staffe: the same shall the Length haue to the quantitie of the same Staffe.

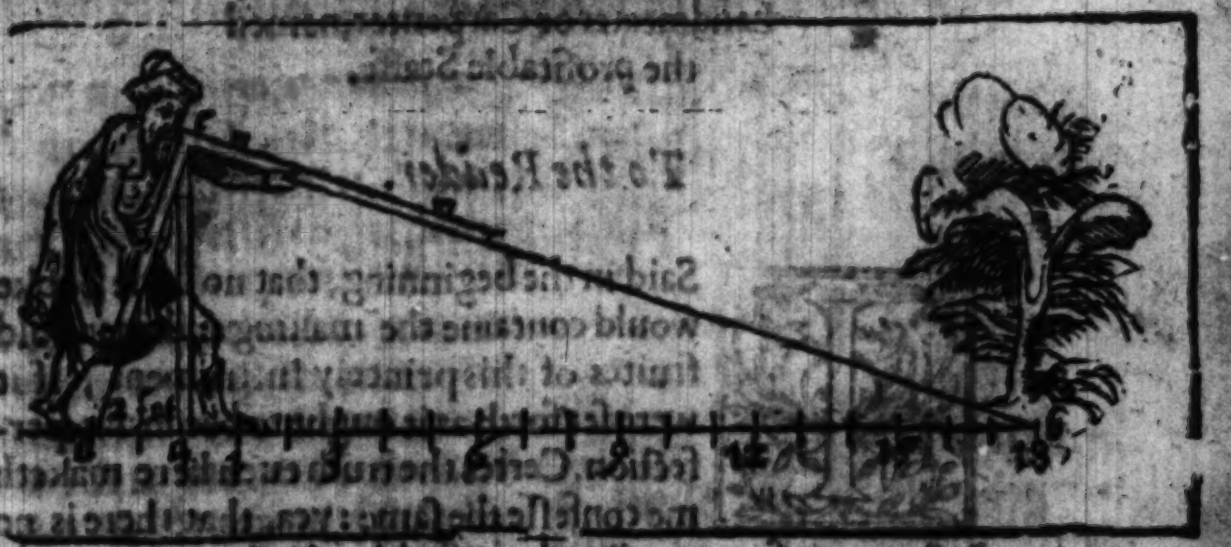
Ensample.

The cause is taken out of Euclide 33. pro. 1. booke & the 4. pro. 6. booke.

The Staffe a.c. in this figure is imagined 6. Foote, and the space a.d. 2. Foot. Considering now that 6. the length of the Staffe containeth 2. thrise, therfore the Longitude desired a.b. of force must containe three times the staffe (which staffe is 6. Foote) that maketh 18. Foote. As this is proued true by a small Ground in the figure following: so the art faileth not in a greater space, which the good Speculator and diligent Practiser by any way can not denie. Yet experience willeth me this to confesse, that the Squire is not conuenient for any long distance, but the Instrument Geometricall (whose ma-

king

king and vse ye may perceiue in the Treatise following) vnlesse ye alleadge some Text of Euclide to your owne, which teacheth knowne, shall stand in stead of your staffe.



A Note.

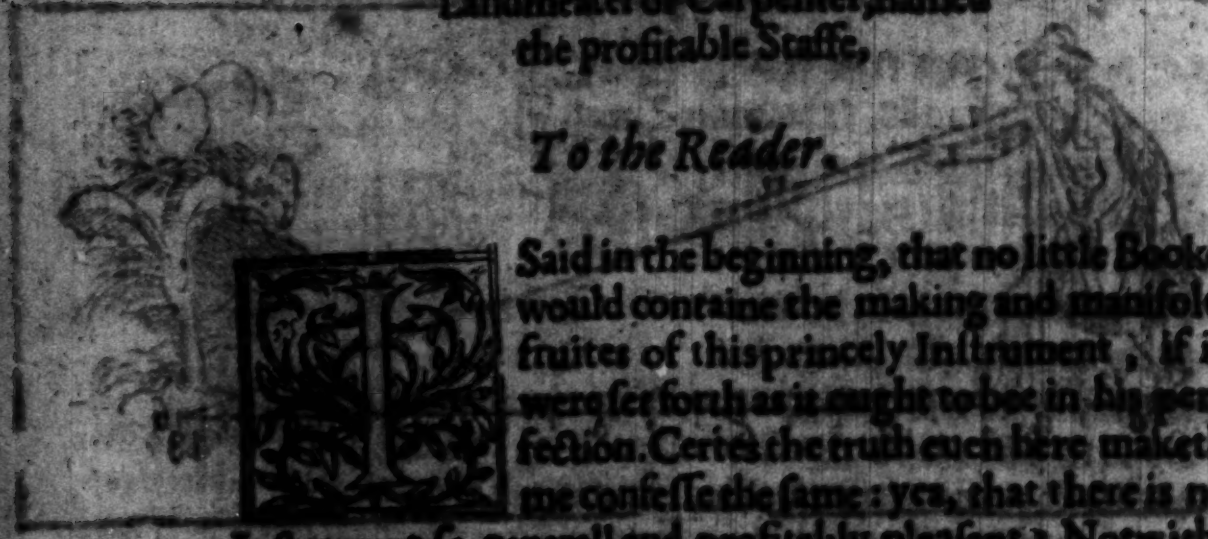
IT behaueth you to haue a fine eye, more fast in the vpper part of your staffe at which marke ye euen with the inward edge of the Squire, and to looke to ye ground where the aforesaid edge of the Squire touches the staffe pointed, as see &c. the other euer them truely directing to the furthest distance.

Marke that the ground must be very plaine and leuel, otherwise it cannot suffice.

Thus the vse of the Squire is here somewhat declared, but more in my generall Prognostication, you most plentifully hereafter (God sparing life) in a Booke called The rare vse of the Squire in practises Mathematicall. In the which Booke profitable pleasant experiences shall be plainly opened (onely of me practised) as well of Perspective, as of the Mathematicals in Generall.

The

A little Treatise declaring the making and vse of an Instrument Geometricall, so farre as it furthereth the Landmeater or Carpenter, named the profitable Staffe,



To the Reader.

I Said in the beginning, that no little Booke would containe the making and manifold fruites of this princely Instrument, if it were set forth as it ought to bee in his perfection. Certes the truth euen here maketh me confesse the same: yea, that there is no Instrument so generall and profitably pleasant: Notwithstanding know (gentle Reader) that the occasion of his chiefe vse and profite is not here ministred: neither to say the truth, doth it appertaine to, or agree with the capacitie of such Artificers. Therefore I shall leane to intreate of his ample large vse and best making, and will set him forth in few words: yea, sufficiently for the Landmeaters capacitie or Carpenters purpose, that at the least they may receiue some kind of fruite with the Geometer. And in time to come (by other meanes) as I see cause, I will largely declare, and there decipher him with his proper beames. Here now followeth

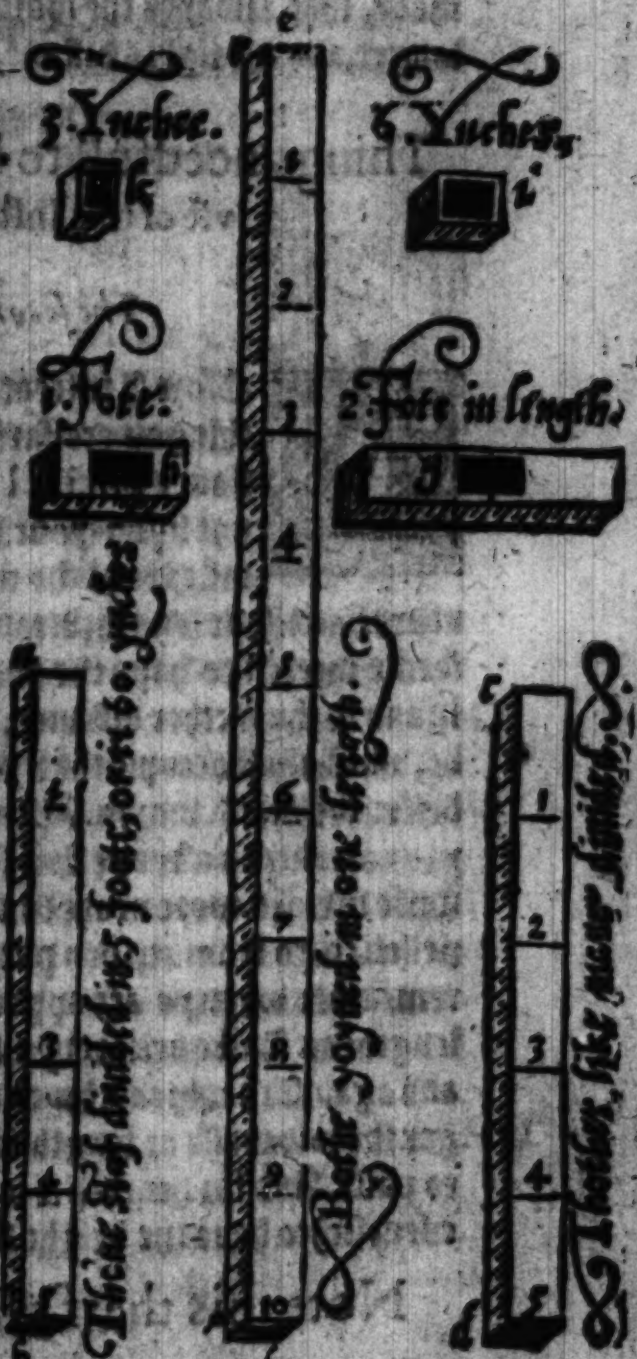
the making, and soberly how he is to be applied for the profit of the aforenamed Artificers.

The

The making of this profitable Rodde or Staffe.

The first Chapter.

YE shall prepare two small, streight, stiffe, rounde, or rather squyre rodes, of metal or of wood, well plained, of like bigneſſe and length. Although it make no matter of what length, yet to auoyde the errours, which little Inſtruments & short staues bring, and also to beare with the more vnlearned handling of such Artificers: let your Rods be each fiue, or of the leaſt three Foote, and euery foote diuided in 12. euen parts or Inches, as ye ſee a. b. ꝯ.d. Theſe rods muſt be forged with a hire in the end of the to ſome readily 10. or 6. Foot in length, (when time requireth) as the figure e. f. ſheweth. Alſo ye muſt get (by the helpe of ſome Craftſmen) 4. other like rods, the longer g. 2. foot: the next h. 1. foote the other i. 6. Inches, then k. 3. Inches, the laſt and ſhorteſt l. 1. Inch, and ½. Each of theſe muſt haue in their vtter ende a hole, that the long ſtaffe of 10. foote may be put through them, and they moued on him at pleaſure vp and downe, alwayes cutting the longer ſtaffe e. f. ſquire-wiſe, and made to take on any diuiſion, as occaſion ſhall be gi-



uen: which all are easily to be perceiued by ye figure folowing, although my rude declaration hath not expressed my meaning.

Here note in the stead of your short staues, ye may haue one crosse staffe two foote long, with fine sundry sights, so artificially made, that alwayes the short staffe shall runne squire vpon the longer, and the sights distant, as ye list to place them.

Things needfull to be knowne before the vse of this Instrument is opened.

The second Chapter.

Before I intreate of this vse, it behoueth to know things necessarie, and first which of the 5. litle staues g.h.i.k.l mentioned in the making, is to be put vpon your long staffe e.f. according to the distance of the marke. Note if your marks be neare hand, be it length, breadth, or height, the longer g. doeth seeme meetest to haue the roome, if more of length, the other h. and so the further distance, the shorter the staffe requireth to be, which shall occupie that place. Ofte practise shewed this better then many words. Also note, if chance be to go in toward your marke (as after ye shal see how) you must moue the short staffe inward more neare to the end of the longer e. If ye be compelled to go from it, then put it from e. toward the end f. Also remember when ye are appointed to measure any breadth or length (as shalbe declared) it behoueth you to stand right with, and against that breadth, yea and the longer the breadth, or larger the wideneſſe or length is, the better the thing will come to paſſe. And for heights it is necessarie (if ye regard all exactneſſe) to haue the height stand directly vp.

Note this that followeth to be generall in all workings.

Ye must stand right vp with your Body and necke, your feet iust together, yor handes not much moouing, the one eye

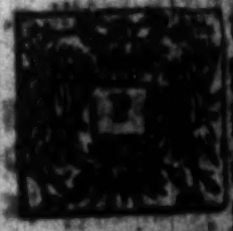
eye closed, and euen marke your standing right with the midst of your face. Be not ignorant here, that I call the extreames of the little staues, the verie endes where the sight euer runneth. And no difference betweene the Altitude and Height, betweene the Longitude and Length, the Latitude & breath. The short staues I name by the letter figured ouer them. Your eye must euer be placed in the ende of the longer staffe e. and with the other eye ye ought to winke.

What these words meane Longitude, Latitude, Altitude.

These trifles and such like omitted, letteth the truth to come to passe, and make men to suspect the Ground, which is most certaine.

How heights standing directly vp, are measured by the Instrument.

The third Chapter.



Set the staffe g. vpon the longer e.f. and moone him his iust length from the beginning of the longer e. turne the ende of g. toward you, and according to that height placing your eye (as is sayd) euer at the beginning of the longer e. with the other eye winke. Then go backe vntill ye may plainly perceiue the verie vpper part of that Altitude, and also the lower ende by the extreames of your shorter staffe g. Now the space of the mooue of your Foote to the base of the height is equall with the Altitude.

Or thus.

When ye shall see any Altitude, whose measure ye require, imagine by coniecture howe oftentimes that height is found in the Space from it vnto your standing. Then moue your shorter staffe (chosen as aboue most conuenient) euen as often his owne length from the beginning of the longer e.

Where your eyes doe glance: Then measure the ends of your little Staffe, your Eye being in a direct line to the height: looke whether your Eye fall on the extremes of your shorter staffe neere toppe, and after lowest part of the height. If not, mount the shorter staffe higher or lower by nearer or farther as ye see cause; and as your conscience tells. Then let your little Staffe remaine, as by experience ye have put, and go toward or from that height until the Altitude agree iustly with the extremes of your shorter staffe. Then marke that place with the midmost of your eyes.

Nowe ye may conclude, that the Height is as often contained in the distance, which is betweene the marke and it, as the Length of that little Staffe is found conteined from the ende of the longer, &c.

Ensample.

How the iust height is knowne.

If the shorte Staffe be ten times his owne length from the Altitude the height containes that shorte distance 10. times iustly.

The Altitude is thus gotten. Bowe your shorte staffe from his late being a length nigher towards or from the as ye see cause in his backe. Then go to or neare vnto it (as before) vntill the verie Summitie, and also the lowest part of the height agree with the extreames of your shorter staffe. The space then betweene your first marked place and this latter, declareth the iust height. Otherwhiles couert impediments, ye shall not haue roome to go the iuste backe or forwards, as the height requireth vnto. This remedie is prouided. Bowe the little staffe halfe his length, and so seeke two stations (as before) vntill the Extreame of the shorter staffe iustly answere either end of the Height. Then the space betweene the two standings must be doubled to haue the iust height. Or if ye list, ye may bowe the shorter, according to the fourth part of his length, or to any portion, as to the fift, sixt, seuenth, &c. then shall ye haue that part of the height betweene the two stations.

A remedy prouided for want of ground.

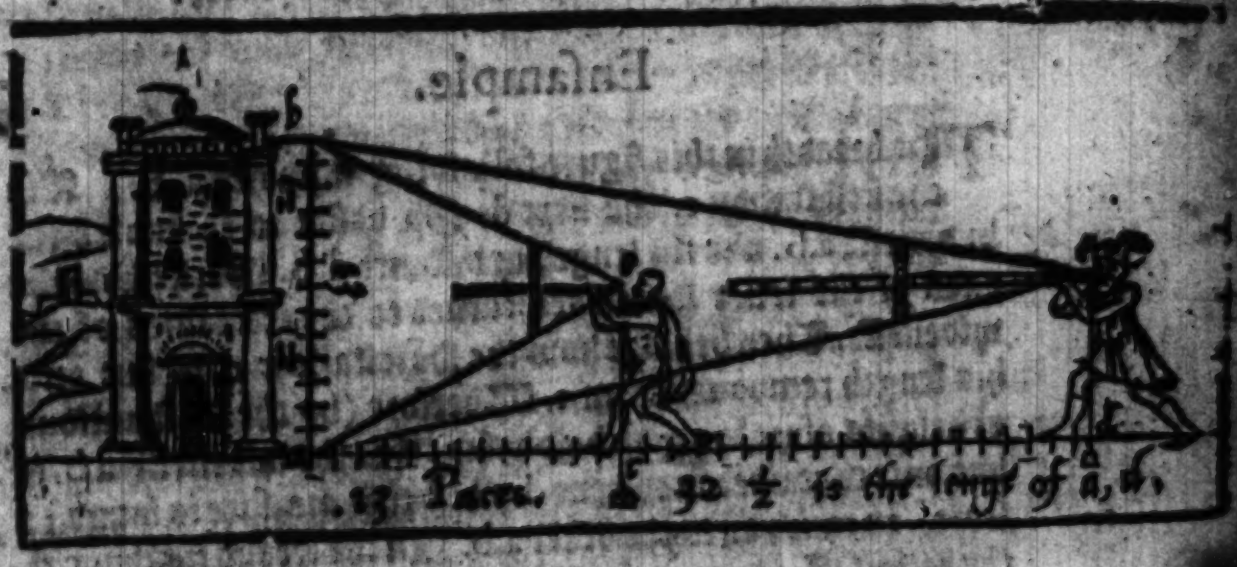
Yet know this (which experience by diligent practise will shew)

shewd the bigger partes ye take, the lesse error ye commit: A little error often multiplied, encreaseth to a great.

Now that all the aforesayd may the better be perceyued, behold the ensample ensuing, as ye may see by figure declared, in the which the height is imagined a.b. the first station c. the short staffe g. is mooued from c. iust his length. I am forced to conclude, that the Base of the height a.b. is from my standing c: euen his precise length. Also then if ye measure that distance of a.c. being 13. paces, ye haue the true height of a. b. as many. In the other standing place d. the shorter staffe is found from c. twise his length and a halfe, wherefore I must affirme the height a.b. to be contained as found in the distance a.d. twise and a halfe: which length a. d. is apparent 32. paces. All this that is spoken of the height may well be vnderstand of Latitudes or wideneſſes, and Lengthes following.

The ground of this may be gathered of Euclide in his perſpectiue. 21. Theo.

In Altitudes this Rule is not perfect except the eye be leuell with the middle of the Altitude.



How the breadth or wideneſſe of things are found, and by them, Length or any diſtance at pleaſure.

The iij. Chapter.

Herfore I haue inſtructed afore of heights, the ſame vnderſtande here of wideneſs, lengths, &c. For none other vſe are Lattrues or wideneſſes ſeene here by this inſtrument, then before is declared of heights, only this excepted, that the ſhort ſtaffe muſt lie contrary, the ends according to the breadth, ſeeing by the extremes of the ſhort ſtaffe the veriie vttermoſt parts or ends of the lattrue, noting your ſtations right with the mid of your foot. And ſo performe all as afore. And as I ſaid, thereof the parts of the height found betweene your ſtandings euen the ſame things is well vſed here, for all maner parts of the breadth.

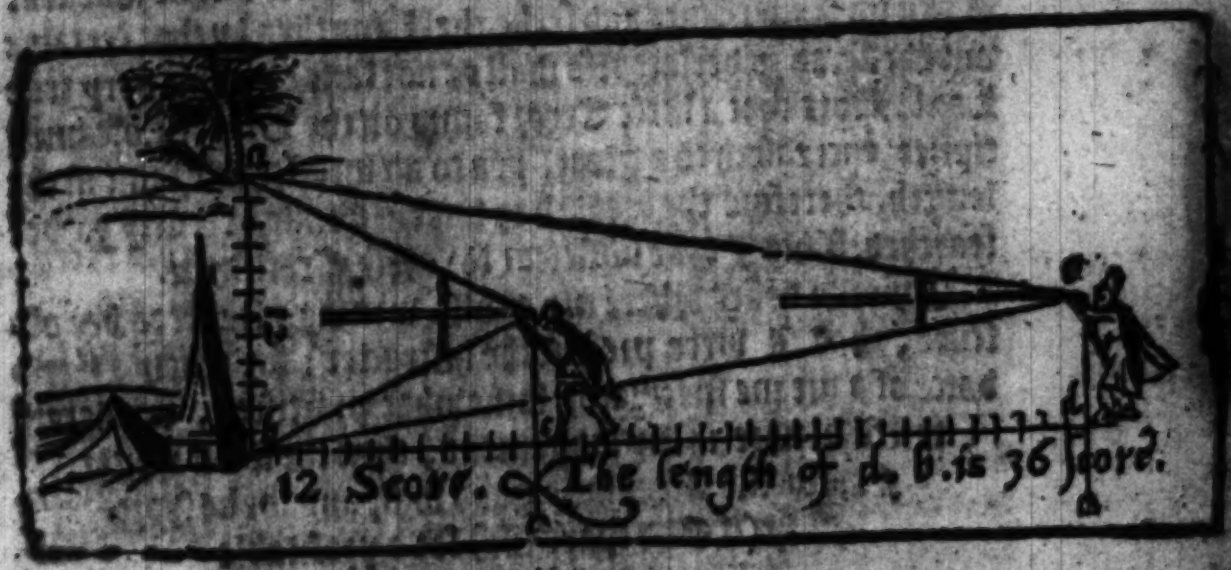
Enſample.

The breadth in this figure following ſuppoſed a. b. Alſo the firſt ſtation c. the next d. My deſire is to knowe the wideneſſe a.b. and the length or diſtance d.b. Marke how the ends of the leſſer ſtaues are turned to the extremes of the wideneſſe. Then beholde how the ſhort ſtaffe in c. is but once his length removed from c. Wherefore (by the inſtructions of heights afore) ye may boldly ſay, that the wideneſſe a.b. is but once contained betweene d.c & b.c & that meaſure is found 12 foote, as much as is the other a.b. In the ſecond ſtanding d. the little ſtaffe is removed three times his length from c. For that cauſe I conclude (and eaſily) from b. to that Station three times the breadth, which breadth is 12. foote. So by the wideneſſe I haue found the length of b.d. 36. foote, my deſire. Thus are Lattrues found, and by them Lengths, &c.

Behold

Behold the figure.

Yee must alway stand directly agaynst the middle of the Breadth.



Whensoeuer any distance is put, whose certaine length ye require: measure (by the art expressed) either the height of any thing there found, or the breadth, and see how oftentimes that Wideneſſe or Length is contained vnto your standing, which knowne: the length can not bee hid, as is declared.

NOw in fewe wordes to conclude, yee may by this Instrument measure the distance of Houses, Steeples, Trees, the length of Walles, the breadth of Ditches, Images in height, and such like. The good wittie Carpenter standing in a place, where hee may plainly see a whole house, or any maner frame with great pleasure, may by this get speedily the true proportion of that house, which he ought to note in a Table, and when time commeth (not without his great prayse) may make, reare and set vp the like. This I take to be sufficient for these Craftsmen. A more larger vse of this Instrument.

Thaue

How the length of land is easily found.

I Haue before forgotten to admonish you wheresoeuer ye list to measure any Land graphically, by the instrument Geometricall named the profitable Staffe, to set vpright a Rodde, the length of a Perch. Or if the distance be long, to passe out, or reache iustly neare fiue or six Perches at the ende of breade of your length, the extreames noted with two diuisible marches. Then go from thence and seeke the Lengthes by that certaine betweene, as is declared: so shall ye not faile to haue very true Land. Note that a little Error found on the Breadth, eft multiplies, encreaseth to a great, yea to an intollerable fault in the length, therefore the breadth of Land ought truely to be searched. This I take sufficient for these Gentlemen.

I would desire where my greene writings seeme to bee obscure, that I were present the instructer: for truely a liuely voice of a meane speculator, somewhat practised, doth more in a fold maner in my iudgement, then the finest writer.

Farewell. Accept my good will, and looke shortly (if God spare life) for a profitable encrease of these matters.

FINIS.

28 MR 59